R E P O R T R E S U M E S

ED 012 223 RE 000 172

NEUROLOGICAL RESEARCH RELEVANT TO READING--1967.

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PUB DATE MAY 67

EDRS PRICE MF-$0.09 HC-$0.60 15P.

DESCRIPTORS- *LATERAL DOMINANCE, *NEUROLOGICALLY HANDICAPPED, *READING DIFFICULTY, LANGUAGE SKILLS, EYE HAND COORDINATION, SERIAL ORDERING, CEREBRAL DOMINANCE,

ASPECTS OF NEUROLOGICAL RESEARCH ARE PRESENTED UNDER THE TOPICS OF NEUROLOGICAL GROWTH AND DEVELOPMENT, CEREBRAL DOMINANCE, "SPLIT-BRAIN" SYNDROME, AND SEQUENCING. THE FIRST TWO AREAS INDICATE THAT ASSESSMENT OF A CHILD'S NEUROLOGICAL DEVELOPMENT MUST TAKE INTO ACCOUNT VARIATION OF RATE AND DEGREE OF DEVELOPMENT, AND THAT THE SIGNIFICANCE OF ABNORMAL NEUROLOGICAL SIGNS IN A CHILD WITH READING DISABILITY MUST BE COMPARED WITH THE FREQUENCY IN A "NORMAL" POPULATION. THE LAST TWO AREAS INDICATE THE COMPLEXITY OF CEREBRAL DOMINANCE AND THAT SEQUENCING AS A STAGE OF DEVELOPMENT MAY CONTRIBUTE TO AN UNDERSTANDING OF READING. (BK)

ED012223

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RE 000 172

NEUROLOGICAL RESEARCH RELEVANT TO READING--1967
Interdisciplinary Session

Dr. Ketchum, Members, Guests:

I shall attempt to adequately substitute for Dr. Silver by acquainting you with certain aspects of neurological research in the area of reading disability and allied fields. Because of the time limitations regarding preparation and presentation of the material selected for your consideration, it must reflect the speaker's personal interests and background. The topics chosen are deliberately eclectic but by no means a complete summary of the material that could be gathered together under this heading. The authors cited are primarily, though not exclusively, physicians, individuals whose professional activities are accomplished in a medical school setting. Corroborating or contrasting material provided by members of other disciplines has been

included to indicate interdisciplinary agreement or argument, as the case may be.

Not all of the material to be considered deals with reading per se. Some relates to closely allied areas, other work is presented to indicate a unique or particularly interesting approach to a neurological problem related to reading disability. Articles published in general medical or more specialized neurological journals have been preferentially selected and are presented as brief, annotated bibliographies. This selection was predicated on the assumption that the majority of you are probably not closely associated with medical schools nor do you regularly peruse abstruse medical journals. Some of the material has been presented at various medical meetings and is summarized here. This is as yet unpublished material and has the disadvantage of not being currently available to you for further scrutiny, but does illustrate some of the variety of neurological research, pertinent to reading, extant today. The last source of material is that of personal acquaintenances who are doing research in the area of reading disability. They have kindly permitted presentation of some of their material here today. Informal reviews of certain institutional activities which are sporadically available are also cited.

Now, having furnished the background and set the stage for the presentation, let us begin with an important area and one of interest to teachers, pediatricians and neurologists.

Neurological Growth and Development

The failure to establish preferential use of eye or hand, or establishment of preferred eye and hand on opposite sides of the body has been considered evidence of incomplete or mixed cerebral dominance

and implicated as causally related to reading disability, by some authors. Studies by Belmont and Birch (2) have shown that the establishment of laterality preference is a function of age. Incidentally, this may change from side-to-side in early years and not be complete until age 11 or 12. Of course, in some adults, with no reading problem, it may never be established. The background of establishment of laterality preference as a function of age must be present in order to assess significance of laterality preference, or its lack, in a given child with reading disability.

Belmont and Birch (2), Rosenberger (19), and Silver and Hagin (21) fail to find a significant increase in the incidence of incomplete or crossed laterality preference in poor, as opposed to good, readers.

Laterality awareness, or the ability to correctly identify right and left on one's body, on another person or in extracorporeal space, is also a developmental phenomenon. These several subfunctions first appear in most normal children at fairly closely defined age ranges. Birch and Belmont (2), and others have indicated the ages at which these various subfunctions "mature" in normal children. In general, recognition of right and left on one's own body is seen in most children around the middle of the first decade of life and ability to perform the most difficult task--right and left ordering of several objects in extracorporeal space is accomplished late in the first, or early in the second, decade of life. Birch and Belmont (2) and Rosenberger (19) find that there is a significantly increased incidence of defective laterality awareness in poor readers.

In interesting contrast--Alexander and Money (1) of Johns Hopkins Hospital, find in patients with Turner's syndrome, a cytogenetic dis-

ordered with disordered development of primary and secondary sex characteristics, deficit of form perception and of directional sense and essentially normal reading skill.

Another area showing developmental change with age is that of associated movements in one hand which mimic those of the other hand performing a task--so called mirror movements. Normal patterns of development presented by Dr. Fog (6) of Denmark show that 90% of 5-6 year old and 10% of 14-16 year old normal children exhibit such movements. The frequency of occurrence is influenced by the emotional and physical state of the children, the nature and relative difficulty of task.

Another kind of movement which has attracted attention is that of "choreiform" movements. Choreiform movements, coupled with reading disability has been termed the "choreiform syndrome" by Prechtl and Stemmer (18).

Stemmer (23) by herself, and Rutter, Graham and Birch (20), in more recent years, have studied larger numbers of children with and without reading disability and find no significant association between choreiform movements and reading disability.

Another group with prominent motor signs are those described by Gubbay, Ellis, Walton, and Court (9). They described a curious group of children with a high incidence of left handedness, right-left disorientation, "crossed laterality", poor handwriting, speech defects, constructional apraxia, squint, abnormal electroencephalogram, inability to dress self even in second decade of life, and other findings sometimes considered indicative of central nervous system pathology and significantly associated with reading disability. Of interest is the fact that some of these children had no difficulty with reading and only

six of the twenty-one patients reported had serious reading disability.

"Cerebral Dominance"

The concept of cerebral dominance and disturbances of it has been considered by some to be importantly related to reading disability. We can appropriately examine it here, its nature and assessment.

Observations have been made at the Montreal Neurological Institute over many years on this problem. Some of these observations have been recently summarized by Milner, et al (17).

The individuals studied and upon whom the observations have been made are those who have a focal seizure disorder which is presumed, after extensive neurological evaluation, to be suseptible to surgical treatment. An important feature of this evaluation is the determination of the cerebral hemisphere dominant for speech. To this end, the Wada test is performed. This consists of the injection of sodium amytal into, first, one carotid artery, and then the other. The purpose of the test is to determine whether the injection of amytal is followed by transient aphasia. The injection of amytal into the carotid artery supplying the "speech-dominant" side will produce the transient, but profound, loss of speech. In assessing the results obtained with this procedure, it is important to realize that this is a highly selective population. Each individual in it already has a clearly established expression of central nervous system disfunction, namely, a seizure disorder.

The speech center was on the left side of the brain in 90% and in the right side in 10% of right handed individuals. There was no bilateral representation of speech in right handed individuals.

The assessment of the Wada test in left handed, or ambidextrous individuals must take into account whether or not there is a history of

early brain damage. The "speech center" was located on the left side of the brain in 64%, on the right in 20% and bilaterally representated in 16% of left handed or amidextrious individuals with no history of early brain damage. Speech was on the right side of the brain in 67%, on the left side in 22% and was bilaterally representated in 11% of left handed or amidextrious individuals with a history of early brain damage.

These observations confirm the hypothesis derived from clinical observation that the cerebral organization of language is less predictible in a left handed or ambidextrious individual than in a right handed one. In 10 instances with bilateral representation of speech, none were right handed. This lends support to the notion that individuals with left handed tendencies show less clear cut unilateral hemispheric localization of language than do right handed individuals.

These observations are, to a degree, to be expected in the light of our knowledge of cerebral function and language vocalization. Of particular interest to educators, especially in the light of the emphasis upon so-called "brain damage" and its effect upon speech localization and one's concept of laterality is the observation that in individuals with a history of unequivocal left brain injury, speech may still reside in the left side of the brain and has not been "transferred" to the opposite side of the brain.

Related observations were reached by Robert Efron (5) of the Veteran's Administration Hospital in Boston. He examined the hypothesis that temporal discrimination is made in the hemisphere dominant for speech. His observations support, but do not establish, this hypothesis.

The results of his experiments suggest that conscious comparison of the time of occurrence of two sensory stimuli (closely related in time) require the use of the hemisphere dominant for language. Sensory messages which carry information as to time of occurrence and are received by the non-dominant hemisphere are transferred to the dominant hemisphere over a longer pathway than the one directly to the dominant hemisphere.

The hemisphere dominant for comparison of time of occurrence is the left in almost all right handed and most left handed adults. The right hemisphere is dominant in this sense for a few left-handed people.

This study, and one with aphasic adults (4), suggests that "much of the consignment of higher functions to the dominant hemisphere will be discarded with recognition that regardless of where the actual centers are located,many functions will appear to be in the dominant hemisphere simply because, to become conscious, the phenomena must submit to this hemisphere's 'temporal analysis.'"

Kimura has suggested that the ear opposite the hemisphere dominant for speech is the better, or more efficient ear, for hearing verbal material (10), (11); the ear on the same side as the hemisphere dominant for speech is more efficient in recognizing snatches of melody (12).

These citations illustrate the "cerebral dominance" is as "cerebral dominance" does. They do not directly relate reading disability to cerebral dominance but indicate the complexity of "cerebral dominance" and clearly indicate the need for caution in any "explanation" of reading disability which oversimplifies the concept of cerebral dominance.

Silver and Hagin (21) are currently utilizing Schilder's extension test as a primary measure of cerebral dominance. This test consists of asking the child to extend his arms, with fingers spread, while his eyes are closed. Usually one hand tends to be slightly higher than the other. The higher hand corresponds to the hand used for writing. If the hand opposite the hand used for writing is higher or if both hands are held at the same level, the test result is considered abnormal. They found that 90% of children with reading disability have either relative elevation of the arm opposite that used for writing or relative elevation of neither arm. Conversely, 96% of children who have an abnormal extension test have a reading disability. This is an interesting observation using an amazingly simple clinical tool. It will prove of great value in diagnosis if the findings are replicated by others.

"Split-Brain" Syndrome

Another avenue offering insight into the nature of cerebral dominance is that of the so-called "split brain" syndrome. The writings of Gazzaniga, Bogen and Sperry (7), (22) and Geschwind (8) are particularly valuable. In brief, the individuals studied were those in whom anatomical connections between the two cerebral hemispheres has been surgically interrupted. Obviously, these are individuals with some medical disorder which resulted in the surgery and are, therefore, not an unselected population.

The number of humans available for studyis necessarily limited but results suggest that performances in which the visual inflow was to one hemisphere only, the required response involving only the hand controlled by the hemisphere, were little affected. Responses requiring interaction or direct cooperation between the two hemispheres are seriously disrupted.

Activities involving speech and writing were well preserved to the extent that they could be governed from the left hemisphere. It was clear that visual information was not transferred from one hemisphere to the other.

Gazzaniga, et al (7) conclude that localization of other functions in the human cerebral cortex can be tentatively located, as follows:

In the minor (usually right) hemisphere:

1. Conception of extra-personal spatial relations
2. Recognition of faces
3. Hearing non-verbal sounds; i.e., clicks or music
4. Performance of block design test
5. May be able to match and comprehend written with spoken words, using only this hemisphere.

In the major (usually left) hemisphere: match (but not reproduce) patterns of blocks.

Investigators at the Veteran's Administration Hospital (3) in Boston suggest that lateral specialization may lie more in motor or executive than the sensory-perceptual component of performance.

"Sequencing"

The term refers to the serial order or spatio-temporal array of letters in words, words in a sentence, etc.

Le Cours and Twitchell (15) presented conclusions drawn from the analysis of spelling errors in intelligent and educated adults with reading disability. A high percentage of the errors were attributed "to one or several of the following mechanisms: 1) addition: for example, several becomes serveral; 2) deletion: for example, elderly becomes eldery; 3) substitution: for example, midnight becomes

mignight and 4) inversion: for example, presence becomes presenec." Le Cours (14) suggests that the phonetic structure of words can occasionally reinforce these errors and that a common denominator in all four types of errors is the presence of pairs of identical letters in a word.

MacNeilage (16) has reached a similar conclusion in analysis of typing errors. He postulates that one of the determinants of language output is a "programming mechanism" which determines the order of units, what will be an integrated sequence and what will not. It is speculated that "the programmer activates, to varying degrees, a number of units stretching some distance ahead of the current response in time." The programmer can be "confused," if you will, by the occurrence of two identical commands at about the same time; i.e., identical letters in a word. The programmer displaces or postpones one of the commands, producing a spelling error.

Rosenberger (19) has concluded that inability to place letters in proper sequence in words is of major significance in poor reading. This is a distinction other than the inability to recognize the individual letters in a word or inability to learn the "meaning" of a word.

Kolers and Katzman (13) of the Massachusetts Institute of Technology have reached similar conclusions from analysis of some individuals' response to identification of letters in certain words. The letters were presented, tachistoscopically, in serial order corresponding to the left-to-right sequence in which they occur when the particular word is written. The authors suggest that there is an "ordering operator" (MacNeilage's "programming mechanism"?) in the visual perceptual system which is aware of the temporal array of letters in

a word before each member of the array is correctly identified. That is, the number of letters in a word is correctly counted but the placement of one or more letters, in left-to-right sequence, may be incorrect.

In summary two areas of developmental neurology and two of, perhaps, broader application have been presented. The former two areas indicate clearly that: 1. Assessment of a given child's nuerological development must take account of the extraordinary variation in rate and degree of development of functions germane to reading achievement; 2. the significance of presumably abnormal neurological signs found in a child with reading disability must be compared with their frequency of occurrence in a normal or unselected population of age-peers. The latter areas indicate: 1. the complexity of the concept of cerebral dominance, that it is currently probably most accurately defined in operational terms and that it may implement our understanding of reading disability; 2. the concept of "sequencing" or spatio-temporal organization of language input and output is in an interesting stage of development and may contribute to our understanding of reading, ordered or disordered.

Bibliography
John B. Isom, M.D.

1. Alexander, Duane and Money, John: "Reading Ability, Object Constancy, and Turner's Syndrome," Perceptual and Motor Skills, 20 (1965), 981-984.

2. Belmont, William and Birch, Herbert, G.: "Lateral Dominance and Right-Left Awareness in Normal Children," Child Development, 34 (1963), 257-270.

3. Brain Research in the Veteran's Administration. V.A. Pamphlet 10-91 (Jan. 1967), 12-13. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

4. Efron, Robert: "Temporal Perception, Aphasia and Deja Vu," Brain, 86 (1963), 403-424.

5. Efron, Robert: "The Effect of Handedness on the Perception of Simultaneity and Temporal Order," Brain, 86 (1963), 261-284.

6. Fog, Elin and Mogens: "Cerebral Inhibition Examined by Associated Movements," pp. 52-57, in Minimal Cerebral Dysfunction, Edited by Bax, Martin and MacKeith, Ronald, William Heineman Medical Books Ltd., London, 1963.

7. Gazzaniga, M.S., Bogan, J.E., and Sperry, R.W.: "Observations on Visual Perception after Disconnexion of the Cerebral Hemispheres in Man," Brain, 88 (1965), 221-236.

8. Geschwind, Norman: "Disconnexion Syndromes in Animals and Man," Brain, 88 (1965), 237-294, 585-644.

9. Gubbay, S.S., Ellis, E., Walton, J.N., and Court, S.D.M.: "Clumsy Children. A Study of Apraxia and Agnosic Defects in 21 Children." Brain 88 (1965), 295-312.

10. Kimura, D.: "Cerebral Dominance and the Perception of Verbal Stimuli," Canad. J. Psychol. 15 (1961), 166-171.

11. Kimura, D.: "Speech Lateralization in Young Children as Determined by Auditory Test," J. Comp. Physiol. Psychol. 56 (1963), 899-902.

12. Kimura, D.: "Left-Right Differences in the Perception of Melodies," Quart. J. Expt'l. Psychol. 16 (1964), 355-358.

13. Kolers, Paul A. and Katzman, Martin T.: "Naming Sequentially Presented Letters and Words," Language and Speech, 9 (1966), 84-95.

14. Lecours, Andre-Roch: "Serial Order in Writing--A Study of Misspelled Words in 'Developmental Dysgraphia,'" Neuropsychologica, 4 (1966), 221-241.

15. Lecours, Andre-Roch and Twitchell, Thomas, E.: "Sequential Errors in Written Language: Their Form, Occurrence and Nature," American Academy of Neurology, 18th Annual Meeting, Philadelphia, Penn., April 25-30, 1966.

16. MacNeilage, Peter,: "Typing Errors as Clues to Serial Ordering Mechanisms in Language Behavior," Language and Speech, 7 (1964), 144-159.

17. Milner, Brenda, Branch, Charles and Rasmussen, Theodore: "Observations on Cerebral Dominance," in Disorders of Language, edited by deReuck, A.V.S. and O'Connor, Maeve. Boston: Little, Brown and Company, 1964.

18. Prechtl, H.F.R. and Stemmer, C.J.: "The Choreiform Syndrome in Children," Develop. Med. Child Neurol., 4 (1962), 119-127.

19. Rosenberger, Peter,: "Visual Recognition and Other Neurologic Findings in Good and Poor Readers," Neurology, 17 (1967), 332 (Abstract).

20. Rutter, Michael, Graham, Philip and Birch, Herbert G.: "Interrelations between the Choreiform Syndrome, Reading Disability and Psychiatric Disorder in Children of 8-11 years," Develop. Med. Child Neurol., 8 (1966), 149-159.

21. Silver, A.A. and Hagin, R.A.: "Specific Reading Disability: Delineation and Relationship to Cerebral Dominance," Comprehensive Psychiatry, 1 (2):126-134.

22. Sperry, R.W.: "The Great Cerebral Commissure," Scientific American 210 (1964), 42-52.

23. Stemmer, C.J.: Quoted by Rutter, Michael, et al, Vide Supra.